SEMI S2 AND EXAMPLES OF A 'WHAT IF' HAZARD ANALYSIS

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Rev #: 2
Rev. Date: 6/20/02

Hazard analyses are used to determine the potential for deviations from or weaknesses in the system design that could pose a hazard to personnel and/or equipment. Hazard Analyses should identify risks, methods to reduce risk, and any actions needed to ensure that the equipment can be operated and maintained safely. Process Hazard Analyses include Failure Modes & Effects Analysis (FMEAs), Checklists, and 'What If' Analyses.

In a 'What If' hazard analysis, brainstorming techniques, in the form of 'What If' questions are used to identify possible deviations and weaknesses in design. Once identified, these concerns and their potential consequences are evaluated for risk. 'What If' hazard analyses can be used to determine system compliance with SEMI S2 requirements to verify that "no single point of failure or operational error should allow immediate exposure of personnel, facilities or community to hazards or directly result in injury, death or equipment loss." The 'What If' Analysis meets SEMI S2 requirements for equipment that does not use 1) 600 v ac or greater or 2) Class 3 or 4 hazardous production materials. This analysis may be completed by the supplier and validated by their third party reviewer or by the supplier working with their third party.

Caution: 'What If' hazard analyses are based on brainstorming. Their thoroughness and accuracy are dependent upon the composition and expertise of the team performing the analysis. In addition, the 'What If' hazard analyses stops at a single point of failure and does not investigate the system further. (i.e., This method would not evaluate a series of failures and the potential consequence of this series.)

Several organizations provide training on process hazard analyses; the following are some examples:

1) Process Safety Institute, a Division of JBF Associations, Inc. http://www.jbfa.com/psi.html
2) American Institute of Chemical Engineers http://www.aiche.org/education
3) Intel Training, Process Hazard Analysis Overview, SAF008012

The following table contains examples of "What If" questions. These questions are based on SEMI S2 requirements for risk assessments.

Examples of 'What If' Analyses Questions:

WHAT if. . .	RISK	METHOD TO REDUCE RISK	ACTION REQUIRED
. . . personnel hazards exist at the loading/ unloading area?	Mechanical Risk □ Cutting □ Shearing □ Crushing	Hardwired based interlock system is integrated with access door. The door is locked by solenoid during automatic operation so that an operator cannot open the door until all the movement stops. When the door is opened, all power to the moving actuators is disconnected by electro-mechanical relays. NRTL listed light curtain is installed on the top of the opening area so that any object moving towards the hazardous area from outside (i.e., human hand) can be detected. Once it is activated, all the movement (of all modules) stops before operator reaches the moving parts. Power supply to the moving actuators is disconnected.	No further action required

WHAT if. . .	RISK	METHOD TO REDUCE RISK	ACTION REQUIRED
		The placing head is adequately covered by enclosure, in order to prevent finger trapping, shearing and drawing-in.	
. . . an N2 Overpressure occurs?	Equipment Damage	Pressure regulator limited to 30 psi. IR Specification for set point of the pressure regulator. Burst pressure of regulator and IR pressure rating of components set.	No further action
. . . vacuum pressure is high (near atmospheric)	Process error resulting in wafer damage	Vacuum presence monitored and system inhibits operation at high vacuum conditions	No further action
. . . vacuum pressure is low	Process error resulting in wafer damage	Vacuum presence monitored and system inhibits operation at low vacuum conditions	No further action
. . . no vacuum pressure	Process error resulting in wafer damage	Vacuum presence monitored and system inhibits operation at low vacuum conditions	No further action
. . . blockage of air between the pressure switch and heater assembly?	Burn-out the heater and smoke, potential evacuation	Add airflow switch	Action required – airflow switch must be installed
. . . voltage is too high?	Dielectric breakdown, overvoltage supplied to components and power supply failure	Test for dielectric withstand; DC power supplies incorporate internal voltage compensations by design	No further action
. . . shutter is activated and spring fails?	Potential for personnel to be exposed to Laser	Shutter is not NRTL approved. Information on laser shutter (i.e., spring failure, internal tests) required	Actions Required -- Info on Laser Shutter needed and Evaluation to be completed
. . . personnel contact electrical components?	Electrical shock	120 vac incoming voltage. Interlocked doors and other enclosures require tool to open. PE in place	No action. Risk level reduced to low or slight
. . . robot x/y axis overruns and hits mechanical bumper?	Mechanical Damage	Linear encoders, hard stops, servo motors are components.	No action needed
. . . low air pressure?	Process error resulting in wafer damage	Air presence monitored and system inhibits operation at low vacuum conditions.	No action needed
. . . high air pressure?	Process error resulting in	System integrates pressure regulator with 145 PSIG maximum. Overpressure fault would be	Action needed.

WHAT if. . .	RISK	METHOD TO REDUCE RISK	ACTION REQUIRED
	wafer damage	generated and air supply shut down at valves	Validate system can withstand 145 PSIG supply pressure

SEMI S2-00 requirements for risk assessments can be found in paragraphs: 6.5, 6.8 and 8.5.1.

Note: Fire Protection Risk Assessments must be completed by a party qualified to determine and evaluate the fire hazards and the potential need for controls.